CORN STALKS VS. FIELD PLOTS AS A GUIDE TO THE FERTILITY REQUIREMENTS OF THE CORN CROP

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This bulletin reports the more important results secured in a study of the value of "corn stalk tests" as a guide to the nitrogen and potash needs of the corn crop. The writers have made more than 2000 nitrate and iron determinations, on corn stalks grown on more than 50 selected plots, whose fertility requirements, as measured by crop yields, are known. The plots represent six of the more important soil types on which corn is grown in the State. The results obtained on any given group of representative stalks selected under conditions as uniform as the eye could detect, were in discouraging numbers highly variable, and therefore impossible to interpret, frequently conflicting and often misleading and unreliable. Farmers of the State are advised against the use of the method as a guide in choosing fertilizers of the corn crop.

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CORN STALKS VS. FIELD PLOTS AS A GUIDE TO THE FERTILITY REQUIREMENTS OF THE CORN CROP

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INTRODUCTION

According to Dr. G. N. Hoffer[1] it is possible to prescribe the fertilizer treatment required by the corn crop in any given field, or part of a field, by first noting certain characteristics of growth made in the field, and then interpreting these in conjunction with results obtained from the making of certain simple chemical qualitative tests on the stalks of the corn plant itself.

This method indicates the nitrogen situation in any given field by the shade of green possessed by the stalks and leaves—a light green indicating a lack, and a dark green an abundance of nitrogen. Further evidence of a confirmatory nature, and based on the assumption that the nitrate content of the soil is reflected in the nitrate content of the stalks grown on the soil, is said to be obtained by splitting a few typical stalks and applying to the internodal tissue a few drops of a 1 percent solution of diphenylamine in 75 percent sulphuric acid. If nitrates are present, a blue color develops, and the greater the quantity of nitrates present the more intense the blue color. If no color develops and the color of the plant be light yellowish-green, nitrogen starvation is indicated. This confirmatory test is made necessary by reason of the fact that all corn does not possess the same shade of green, some strains being naturally lighter in color than others.

A suspicion that potash is deficient should be aroused, it is claimed, by such things as a premature dying of plants, the prevalence of broken shanks, or the development of root rots. If conditions of this nature obtain in the field, then a lack of potash is said

[1]Bulletin 298, Indiana Agricultural Experiment Station.

to be indicated, and a confirmatory test for iron should be made on the nodal tissue of a few representative stalks. The desirability of the iron test is based on the hypothesis that a deficiency of potash in the soil results in an abnormal accumulation of iron in the nodes or joints. The iron test is made by first splitting the stalks lengthwise and then adding to the freshly cut nodal tissue a few drops of a 10 percent solution of potassium thiocyanate followed by the addition of a drop or so of a diluted solution of hydrochloric acid. The development of a red color indicates the presence of iron and, simultaneously, if in abundance, a lack of potash. The greater the intensity of the color the more urgent is the need for potash.

To study the phosphorus situation by this method no chemical tests on the plant itself are employed, but reliance is based entirely on the appearance of the plants in the field and the reaction of the soil. If the plants are stunted and the soil is acid, then, in the absence of any sign of lack of nitrogen or potassium, a deficiency of phosphorus is suggested.

OBJECT

In this paper the purpose is to study the reliability of the cornstalk method, or "Fertometer",[2] as applied to Ohio soils. The importance of the method, if dependable, due principally to the speed, simplicity, and economy with which it can be applied, and the results obtained, is of so great moment to the interest of Ohio corn growers that it was thought necessary in the summer of 1926 to undertake such a study.

MATERIAL AND METHODS

The chemical tests for nitrates and iron were applied to corn plants grown on fertility plots situated on six different experiment farms: the Station farm at Wooster, Wayne County; the special corn borer station farm at Bono, Lucas County; and the Paulding, Madison, Clermont, and Trumbull county experiment farms. These particular farms were chosen because collectively they represent most of the leading soil types of the State.

On each of these farms corn is grown in rotation with other crops, some of which are also fertilized. The particular plots chosen were those on which the fertilizer treatments are so designed as to bring out the needs of the soil for nitrogen and potassium.

[2]Successful Farming, October, 1926. p 5

As a rule, the samples consisted of six stalks. Ordinarily the chemical tests were applied to the lower part of the stalk and the microscopic tests for potassium were made in the region of the ear.

The results of the chemical tests obtained from the various plots on each farm are tabulated in connection with the yields of corn, thus making available a ready comparison of the nitrogen and potassium requirements as measured by the corn-stalk and field-plot methods. The yields of corn are based on the average production for the last five years, 1921 to 1925 inclusive. The kinds of fertilizer and the rate per acre at which they have been applied to the corn crops are also given in the tables.

RESULTS OBTAINED AT DIFFERENT FARMS
WOOSTER, WAYNE COUNTY

The soil at Wooster is classified as Wooster silt loam. It is derived from glacial sandstone and shale material, has a porous subsoil, and occupies a topographic position which has favored good natural drainage.

The plots from which the plants were taken have been under treatment for 33 years. The corn is grown in a five-year rotation of corn, oats, wheat, clover and timothy.

Nitrates.—In this rotation there are four pairs of plots on which the treatment has been such as to indicate the reaction of the soil to the use of nitrogenous fertilizers. These are plots 4 and 5, 8 and 11, 11 and 12, and 18 and 20. The results obtained from the corn plants grown on these plots are given in Table 1.

TABLE 1.—Nitrate Tests at Wooster (Unlimed)

Plot	Fertilizers applied to corn				Five year average yield	Nitrates* found in stalks
	Acid phosphate	Muriate of potash	Nitrate of soda	Manure		
	Lb.	*Lb.*	*Lb.*	*Tons*	*Bu.*	
4	.....	.....	.....	.....	12.80	T
5	.....	.....	160	.....	18.24	+
8	80	80	.....	.....	29.82	T
11	80	80	160	.....	39.16	++
12	80	80	240	.....	48.17	+++
20	.....	.....	.....	4	27.71	+
18	.....	.....	.....	8	46.84	+++

* — = none
T = trace
\+ = slightly more than a trace

From Table 1 it will be noted that in each pair of comparable plots, the nitrate content of the stalks is higher where nitrogenous fertilizers have been used, and they are most abundant on plots 12

and 18, where these fertilizers have been used in most liberal quantities. In general the results indicate a low supply of available nitrogen, yet in no case is nitrogen starvation indicated, for even on the poorest plots there is at least a trace of nitrates. That a general need for nitrogen prevails is indicated by the fact that in every case where nitrate of soda was applied a marked increase in yield was obtained. This condition, however, as may be noted from the low yields and relatively high application of nitrate of soda, is rather extreme.

To be of real service, a method should differentiate satisfactorily between conditions in which moderate differences in need for nitrogen exist. That this method may not measure such differences is suggested by the results obtained on plots 5 and 11. The yield of plot 11, due to the addition of acid phosphate and muriate of potash, is more than double that of plot 5. The available nitrates therefore must be distributed thru twice the amount of material. Since both plots receive the same amount of nitrate of soda, then, the nitrates in the stalks grown on plot 11 should be less concentrated than in those grown on plot 5. This is contrary to the results obtained. By the same process of reasoning a similar conclusion is reached from the results obtained on plots 4 and 8.

Potash.—Iron determinations were made on three pairs of plots: 4 and 3, 2 and 8, and 6 and 11. The results are given in Table 2.

TABLE 2.—Iron Tests at Wooster (Limed)

Plot	Fertilizers applied to corn			Five-year average yield	Iron found in stalks
	Acid phosphate	Muriate of potash	Nitrate of soda		
	Lb.	*Lb.*	*Lb.*	*Bu.*	
4	.....	.....	.....	25.31	D−
3	.....	80	.....	45.16	D+
2	80	.....	.....	30.94	C+
8	80	80	.....	51.84	C
6	80	.....	160	32.70	D−
11	80	80	160	58.46	D

* C = Amount of iron in normal plants
D = A greater quantity of iron than C but still not a deficiency of potassium
E = A deficiency of potassium

Assuming the values for C, D, and E as designated in the note, it must be concluded from Table 2 that potash is not needed on this soil, for on none of the plots was there enough iron to grade as E. However, the addition of muriate of potash has in all cases resulted in a marked increase in yields. When potash was used alone as on

plot 3, the yield was increased 19.85 bushels, or 78 percent, over that produced on plot 4, which received none. The increase of plot 8 over plot 2 was 20.9 bushels, or 67 percent. This increase must be attributed to potash, for both plots 2 and 8 receive the same amount of acid phosphate and neither receives any nitrogen. The increase of plot 11 over plot 6 amounted to 25.76 bushels, or 79 percent. In this case also the increase must be attributed to potash, for each plot receives the same quantities of acid phosphate and nitrate of soda.

Moreover, chemical analyses of the soil show that the quantity of available potassium amounted to 46 and 72 pounds per acre on plots 4 and 3, respectively; 34 and 60 pounds on plots 2 and 8, respectively; and 34 and 62 pounds on plots 6 and 11, respectively. These quantities represent the amounts soluble in centinormal nitric acid, found in the surface layer to a depth of 6⅔ inches.

Altho potash increased the yield in each of the three comparisons, yet in no instance did a test show a difference in iron sufficiently marked to be easily noted. The likeness of each pair was similar to that of plots 2 and 8, which is illustrated in Figure 1.

BONO, LUCAS COUNTY

The soils on this farm are heavy dark colored soils derived from calcareous lacustrine deposits. They are classified as Maumee clay. The soil in the region is heavier than the average for the type. The fertilizer plots were established in 1926. The samples, therefore, were taken from the first year's crop, and no yields with which to compare the results are yet available.

Nitrates.—For a study of the nitrates, corn stalks were selected from plots 2 and 15, the former receiving nothing and the latter acid phosphate and manure, applied broadcast, and a mixed fertilizer applied in the row. The results obtained are presented in Table 3.

On plot 15, the heavily fertilized one, there was a slight increase in the nitrate content of the stalks.

TABLE 3.—Nitrate Tests at Bono

Plot	Fertilizers applied to corn			Nitrates found in stalks
	Acid phosphate	Mixed fertilizer 3-12-4	Manure	
	Lb.	*Lb.*	*Tons*	
2	0	0	0	++
15	225	100	8	+++

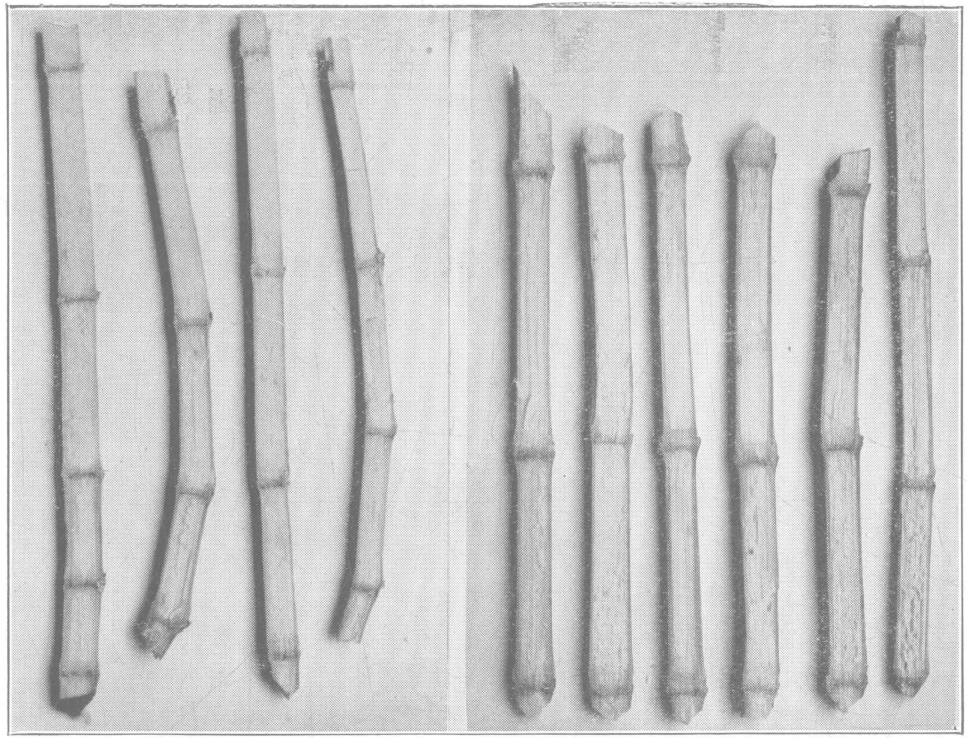

Fig. 1.—These corn stalks were grown at Wooster on plots 2 (left) and 8 (right). Both plots have been fertilized regularly during the last 33 years, plot 2 receiving acid phosphate alone and plot 8 acid phosphate and muriate of potash. Note the similarity in density of iron bands at the nodes.

Potash.—For the iron tests, corn stalks were selected from plots 17 and 18, both of which received the same amount of phosphorous and the latter some potassium in addition. In both cases the fertilizers were applied in the row. The results obtained are given in Table 4.

TABLE 4.—Iron Tests at Bono

Plot	Fertilizers applied to corn		Iron found in stalks
	Acid phosphate	Mixed fertilizer 0-12-4	
	Lb.	*Lb.*	
17	150	.....	C+
18	.....	200	C

In neither case was a need for potash indicated, but on plot 18, which received some potash, there was present a slightly smaller quantity of iron.

PAULDING COUNTY

The soil on the Paulding County farm is quite unlike that at Wooster. It is a heavy phase of the Brookston clay. It is glacial limestone soil, within the glacial lake-plain of northwestern Ohio, and derived from very heavy drift. Altho considered a dark soil the original layer is shallow (about 5 inches) and the content of organic matter is only moderate in amount.

The plots on this farm from which the corn stalks were taken have been under treatment for 13 years. The corn is grown in a four-year rotation of corn, oats, wheat, and clover.

Nitrates.—For the nitrate tests, samples were taken from plots 3, 5, and 9, the first two of which received chemicals and the last one phosphated manure, that is, manure to which acid phosphate is added as it accumulates in the stable. The results are presented in Table 5.

TABLE 5.—Nitrate Tests in Paulding County

Plot	Fertilizers applied to corn				Five-year average yields	Nitrates found in stalks
	Acid phosphate	Muriate of potash	Nitrate of soda	Manure		
	Lb.	*Lb.*	*Lb.*	*Tons*	*Bu.*	
3	200	50	.....	.....	58.42	T
5	200	50	50	.....	63.73	++
9	200	.....	.....	8	62.77	++

On this farm the nitrate results obtained from stalks on plot 3, receiving no nitrate of soda, were conflicting, for on the individual stalks the nitrates ranged from nothing to a liberal amount. If nothing or a trace be accepted as representing the average, then the indication is that no nitrogenous fertilizer is needed, for the color of the plants was dark green. Such a conclusion does not harmonize with the yields, for on plots 5 and 9, which receive nitrogenous fertilizers, the former nitrate of soda and the latter stable manure, the yields were increased.

Potash.—For the iron tests corn stalks were taken from plots 2, 3, and 4.

TABLE 6.—Iron Tests in Paulding County

Plot	Fertilizers applied to corn		Five-year average yield	Iron found in stalks
	Acid phosphate	Muriate of potash		
	Lb.	*Lb.*	*Bu.*	
2	200	.....	57.29	D—
3	200	50	58.42	C
4	....	. .....	59.79	C—

The iron tests indicate that plot 3 is in lesser need of potash than plot 2, but in greater need than plot 4. According to the treatments it should be in less need than either plots 2 or 4, for neither of them receives any potash. In no case is the amount of iron found sufficient to indicate an actual need for potash. The similarity of the yields also indicates little or no need for potash on this soil.

MADISON COUNTY

The soils on the Madison County farm are glacial limestone soils of two types, the light colored Miami silty clay loam and the moderately dark Brookston silty clay loam. Both are relatively fertile. The depth to carbonates is from 24 to 30 inches.

The plots on this farm from which the corn stalks were taken have been under treatment for seven years. The corn is grown in a four-year rotation of corn, corn, wheat, and clover.

Nitrates.—Two comparisons were made: one between plots 3 and 5, the other between plots 9 and 11, both of the latter of which received phosphated manure, but one four times as much as the other.

TABLE 7.—Nitrate Tests in Madison County

Plot	Fertilizers applied to corn				Five-year average yield	Nitrates found in stalk
	Acid phosphate	Muriate of potash	Nitrate of soda	Manure		
	Lb.	*Lb.*	*Lb.*	*Tons*	*Bu.*	
3	160	80	.....	.....	62.30	+
5	160	80	30	.....	61.83	+
9	320	.....	.....	8	68.37	+++
11	180	.....	.....	2	65.37	+++
4	.....	.....	.....	.....	53.72	++

In neither comparison is the fertilizer application reflected in the nitrate content of the stalks, for on both plots of each pair it is equal. The nitrate content of the stalks grown on the manured plots is greater than that of the plots fertilized with chemicals, but equal only to that of the stalks grown on plot 4, an unfertilized plot.

Potash.—On this farm the potash study was made on corn stalks selected from plots 2, 3, and 4.

TABLE 8.—Iron Tests in Madison County

Plot	Fertilizers applied to corn		Five-year average yield	Iron found in stalks
	Acid phosphate	Muriate of potash		
	Lb.	*Lb.*	*Bu.*	
2	160	.....	59.11	C
3	160	80	62.30	D—
4	.....	.....	53.72	C—

According to the corn-stalk tests, potash was present in least amount on plot 3, the only one of the group to which it is applied. In no case, however, was an actual need for potash indicated as none of the plots were graded E. The yields of corn indicate a slight response from the use of potash.

CLERMONT COUNTY

The soils on this farm have been derived from the weathering of old limestone glacial drift. They are very acid, having been leached of carbonate to a depth of 8 to 10 feet. The gray soil which has poor natural drainage is classified as Clermont silt loam; the grayish-brown soil with fair drainage, as Rossmoyne silt loam. The productiveness of this soil is very low.

The plots from which the corn stalks were taken have been under treatment for 13 years. The corn is grown in a four-year rotation of corn, soybeans, wheat, and clover.

Nitrates.—Corn stalks were selected from plots 3, 4, 5, 8, and 9, showing results as given in Table 9.

TABLE 9.—Nitrate Tests in Clermont County

Plot	Fertilizers applied to corn					Five-year average yield	Nitrates found in stalks
	Acid phosphate	Muriate of potash	Nitrate of soda	Manure	Limestone		
	Lb.	*Lb.*	*Lb.*	*Tons*	*Tons*	*Bu.*	
3	200	50	.....	.....	.....	48.66	—
5	200	50	50	.....	.....	49.48	T
8	.....	.....	.....	8	.....	62.91	T
9	.....	.....	.....	8	2	59.59	T
4	.....	.....	.....	.....	.....	22.37	—

The stalks grown on plots 3 and 4, neither of which received any nitrogenous fertilizer, contained no nitrates. The stalks grown on the other three plots, 5, 8, and 9, contained a trace only. Moreover the color of the leaves of corn on all the plots, especially 3, 4, and 5, was light yellowish-green. Therefore, both the general appearance of the plants in the field and the confirmatory nitrate tests indicate a great need for nitrogen, yet an application of nitrate of soda at the rate of 50 pounds per acre on plot 5 increased the yield over plot 3, which receives no nitrate, less than a bushel per acre.

Potash.—The response of this soil to potash is indicated by the yields obtained on plots 2 and 3. Therefore corn stalks were selected from these two plots; also from plot 4, a check.

TABLE 10.—Iron Tests in Clermont County

Plot	Fertilizers applied to corn		Five-year average yield	Iron found in stalks
	Acid phosphate	Muriate of potash		
	Lb.	*Lb.*	*Bu.*	
2	200	.....	33.74	D—
3	200	50	48.66	D
4	.....	.....	22.37	C

Altho the results otained from plots 2 and 3, which are illustrated in Figure 2, are not significantly different, they indicate the presence of a relatively smaller quantity of potash on plot 3, which receives muriate of potash, than on either plot 2 or 4, neither of which receives any potassium. While the chemical tests do not indicate an actual need for potash on any of the plots, the supplementing of acid phosphate with muriate of potash at the rate of 50 pounds per acre has increased the yield 14.92 bushels, or 44 percent.

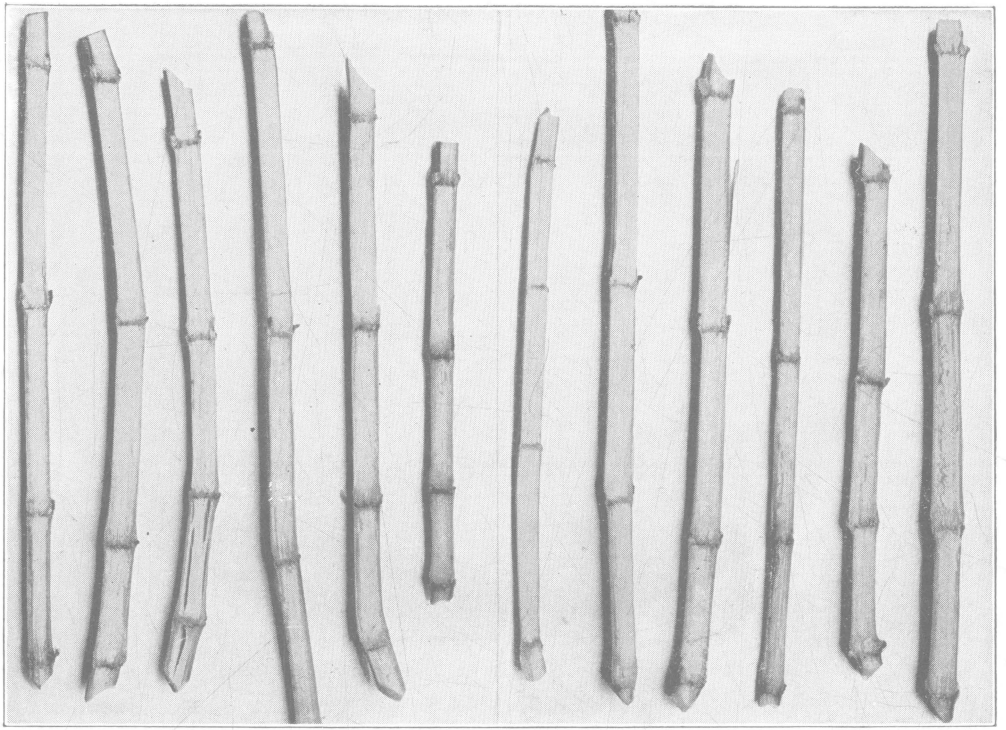

Fig. 2.—These corn stalks were grown at the Clermont County farm on plots 2 (left) and 3 (right). Both plots have been systematically fertilized for the last 13 years, plot 2 receiving acid phosphate alone and plot 3 acid phosphate and muriate of potash. The iron bands appear as pronounced in plot 3 as in plot 2.

TRUMBULL COUNTY

The soils on the Trumbull County farm have been derived from very heavy glacial sandstone and shale material. The subsoils are extremely heavy and naturally poorly drained. The gray soil is called the Trumbull silty clay loam. An acid condition is characteristic of these soils.

The plots, 3, 5, and 9, from which the corn was selected are in a four-year rotation of corn, oats, wheat, and clover, and have been under treatment for 12 years.

TABLE 11.—Nitrate Tests in Trumbull County

Plot	Fertilizers applied to corn			Five-year average yields	Nitrates found in stalks
	Acid phosphate	Muriate of potash	Nitrate of soda		
	Lb.	*Lb.*	*Lb.*	*Bu.*	
3	200	15	.....	41.88	+
5	200	15	44	43.94	T
9	375	80	260	50.03	+

The applications of nitrate of soda are not reflected in the nitrate content of the stalks, for on neither plot 5 nor 9 is it any greater than on plot 3 which receives no nitrate. As a whole, the results do not indicate a need for nitrogen, for in no case was there an entire lack of nitrates, and the color of the stalks was moderately dark green. Neither do the yields indicate a need for nitrogen, for the use of nitrate of soda in connection with acid phosphate and muriate of potash has not increased the yield sufficiently to make the use of it a profitable investment.

Potash.—The treatments are such that the potash requirements can be estimated from plots 2 and 3, and from plots 9 and 12. Accordingly corn stalks for testing were gathered from these four plots, also from plot 4, a check, with results as given in Table 12.

TABLE 12.—Iron Tests in Trumbull County

Plot	Fertilizers applied to corn			Five-year average yield	Iron found in stalks
	Acid phosphate	Muriate of potash	Manure		
	Lb.	*Lb.*	*Tons*	*Bu.*	
2	200	.....	.....	40.93	D
3	200	15	.....	41.88	D—
9	240	.....	4	56.74	D
12	240	40	4	54.88	D—
4	.....	.....	.....	33.80	D

On this farm the applications of potash had little effect on the iron content of the nodal tissue, for all graded D or D —. The similarity of plots 9 and 12, the latter receiving muriate of potash at the rate of 40 pounds per acre, is illustrated in Figure 3. As a whole the iron tests do not indicate a shortage of potash, but in comparison with the other farms the indicated need is as great or greater than any of them. However, the use of potash in connection with acid phosphate has not increased the yield enough to make the use of it a profitable investment.

DISCUSSION

As stated on page 286, the corn stalk method does not employ chemical tests on the plant itself to determine the phosphate requirement. Chief reliance is placed on the development of the corn in the field and the reaction of the soil. If the plants are stunted and the soil is acid, a need for phosphorus is said to be indicated.

Perhaps the use of phosphatic fertilizers on acid soil will give greater gains than its use on soils that are not acid, but the instances are many in which acid phosphate has given profitable returns on well limed soils and where the plants are normally thrifty and not stunted. For example, in the so-called manure test at Wooster, there are two plots, both of which receive stable manure at the rate of 8 tons per acre, and one of them receives an additional treatment of acid phosphate at the rate of 320 pounds per acre. Both have been well limed. The plants have always been thrifty. The acid phosphate has increased the yield 10.68 bushels per acre. Moreover on all fourteen experiment farms in Ohio, the use of acid phosphate on well limed soil and on which no stunted plants appear, has, in every instance except one, given a profitable increase in the yield of corn.

Regarding the manipulation of the tests themselves, considerable difficulty has been experienced in securing uniform results on any given group of stalks. Frequently the variation found in a group of six or eight stalks taken from a plot on uniform soil was as great as that found between two groups selected from different types of soil, or from the same type of soil but with different treatments. The difficulty is enhanced by reason of the fact that the nodal tissue is often slightly discolored. Frequently the lack of uniformity in a group of stalks selected at random from uniformly treated soil was similar to that illustrated in Figure 4 (left). Perhaps such variations are due in part, at least, to the heterozygous

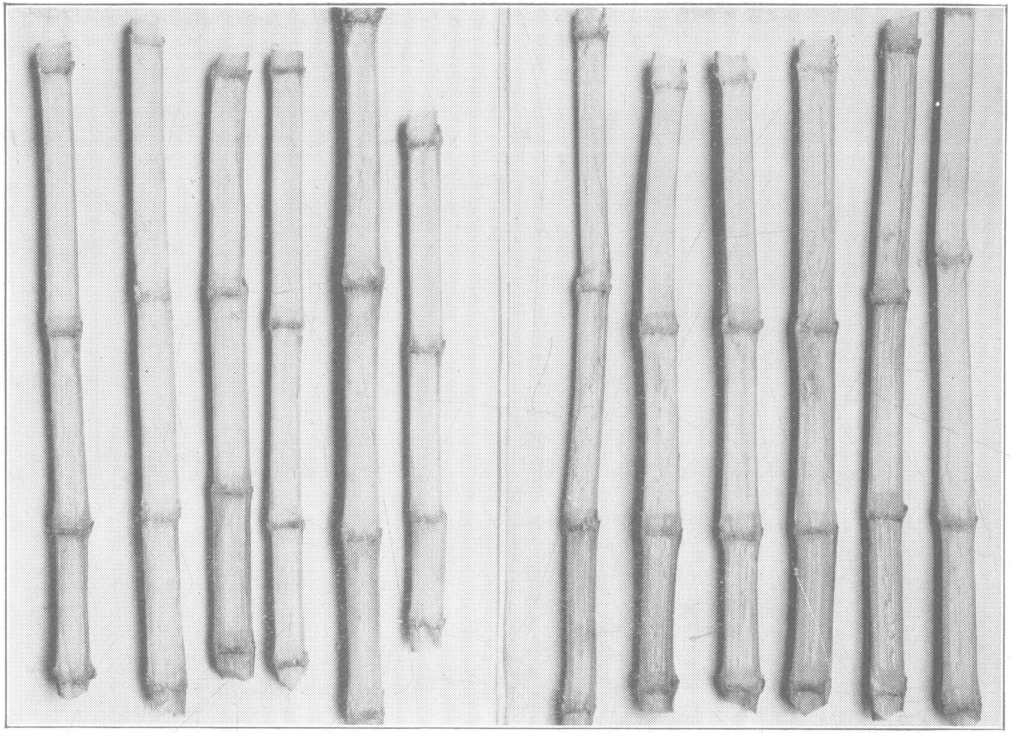

Fig. 3.—These corn stalks were grown at the Trumbull County farm on plots 9 (left) and 12 (right). Both plots have been fertilized regularly for the last 12 years, plot 9 receiving phosphated manure alone and plot 12 phosphated manure and muriate of potash. The addition of potash does not seem to have reduced the accumulation of iron at the nodes.

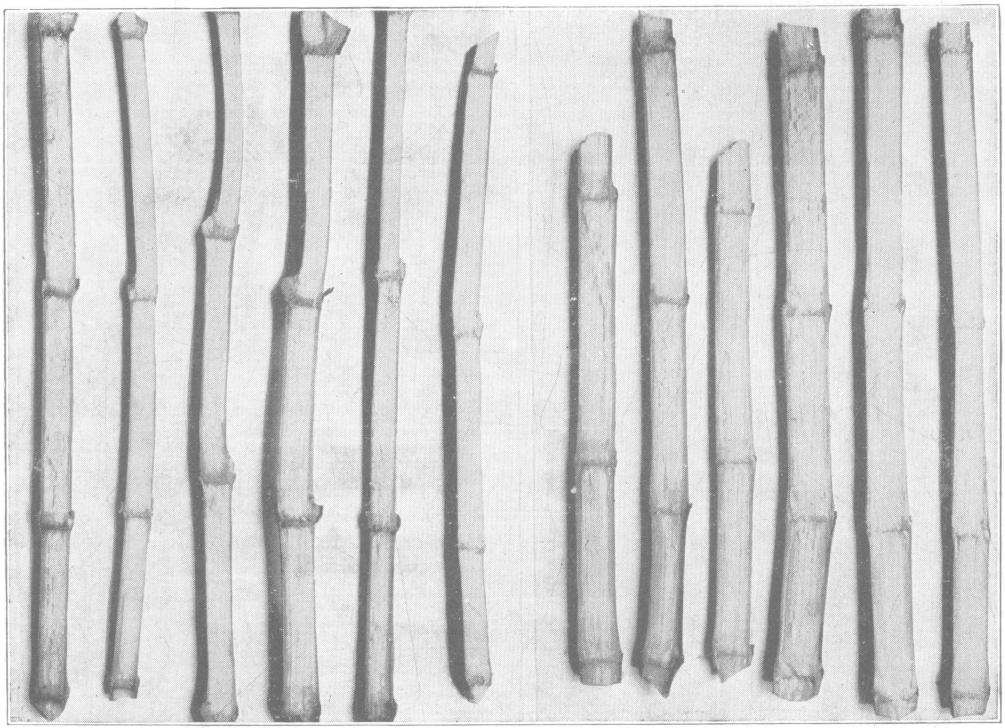

Fig. 4.—The corn stalks illustrated at the left were grown on a plot which has been regularly fertilized for the last 13 years. The density of iron bands varies widely in individual stalks. In inbred corn stalks shown at the right the iron bands are perhaps more uniform.

nature of the corn plant; for inbred material, illustrated in Figure 4 (right), seems to be more uniform. In making the nitrate tests, greater uniformity of results was obtained when the solution was applied to cross sections rather than to longitudinal sections.

Much variation was found also in determinations made at different times of the year. On Burr-Leaming corn grown on a group of fertilizer plots at Wooster, determinations were made at weekly intervals, the results of which are given in Table 13.

TABLE 13.—Nitrate and Iron Tests Made at Intervals of One Week

Date of sampling	Plot 1		Plot 12		Plot 8		Plot 11		Plot 24	
	0—16—0 225 lb. brd.		3—12—4 200 lb. brd. 100 lb. in row		0—12—4 300 lb. brd.		3—12—4 300 lb. brd.		10—44—6 125 lb. in row	
	N.	Fe.	N.	Fe.	N.	Fe.	N.	Fe.	N.	Fe.
7—19	++	++	++	−	++	+	+	+	+++	+
7—26	+	+	−	+	+	−	−	−	−	+
8—2	+	−	++	+	+	−	+	−	+	T
8—9	++	++	++	+	.....	.....	.....	.....	++	+
8—16	+	++	++	+++	+	++	++	+++	++	++++
8—23	+++	+	++	+	T	T	−	T	++	+
8—30	+	+	++	+	++	++	++	T	+++	+++
9—13	+	T	++	T	++	++	−	+	++	++
9—20	+++	++	+++	T	+++	−	+++	+	++++	+
9—27	+++	T	+++	+	+++	−	++	+	.....	.....

From this table it is clear that the conclusion drawn from these tests would vary considerably, depending on the time of year at which they were made.

In this connection it would be of interest to know what variation, if any, in results would be found in years of high and low production—years, for example, like 1909 and 1910 when the corn on the Station farm yielded 105 and 43 bushels per acre, respectively.

Further difficulty experienced in interpreting results was occasioned by the fact that frequently in stalks giving a good test for iron, potash showed in abundance under the microscope. This situation is illustrated in Figure 5, the tests for the potash and iron having been made on the same stalk.

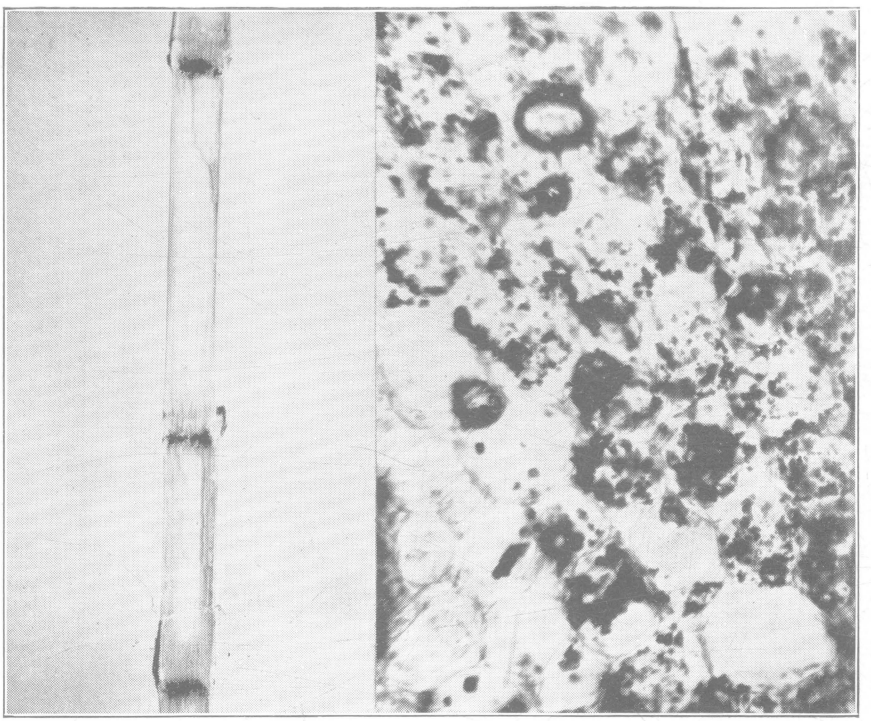

Fig. 5.—In the stalk showing iron bands (left) there was found also the crystals of potassium platinic chloride (right). In the same stalk, therefore, there was indicated by one test a lack and by another test an abundance of potash.

SUMMARY

Nitrates.—The nitrate determinations indicate a moderate need for nitrogen at Wooster and a decided need for it at Clermont County. At the other farms, the results were indefinite. At all the farms except Madison the use of nitrate of soda in connection with acid phosphate and muriate of potash has increased the yield of corn; but at present valuations of corn and fertilizer nitrogen the increase has been profitable only at Paulding, and in the case of some treatments, at Wooster.

Potash.—At no farm was the amount of iron found in the stalks sufficiently great to indicate an actual need for potash as prescribed by the corn-stalk test. The nearest approach to such need was found in the corn grown on the Clermont and Trumbull County farms, an occasional stalk at Clermont and several at Trumbull, early in the season, grading E. At the Clermont County farm the use of muriate of potash has increased the yield of corn per acre 14.72 bushels; at Trumbull County 0.95 bushel.

Phosphate.—The use of acid phosphate on well-limed soil, that produces corn whose growth could not be regarded as stunted, has given a profitable return on all except one of the fourteen experiment farms in the State.